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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



In Re Application of:

Applicants: : Pirooz Vatan et al.
Serial No. : 10/068,462
Filing Date : February 7, 2002
Title of Invention : METHOD OF AND SYSTEM FOR PRODUCING HIGH-
RESOLUTION 3-D IMAGES OF 3-D OBJECT SURFACES
HAVING ARBITRARY SURFACE GEOMETRY
Examiner : n/a
Group Art Unit : 2876
Attorney Docket No. : 108-151USAN10

Honorable Commissioner of Patents
and Trademarks
Washington, DC 20231

INFORMATION DISCLOSURE STATEMENT
UNDER 37 C.F.R. 1.97

Sir:

In order to fulfill Applicants' continuing obligation of candor and good faith as set forth in 37 C.F.R. 1.56, Applicants submit herewith an Information Disclosure Statement prepared in accordance with 37 C.F.R Sections 1.97, 1.98 and 1.99.

The disclosures enclosed herewith are as follows:

U.S. PUBLICATIONS

<u>NUMBER</u>	<u>FILING DATE</u>	<u>TITLE</u>
6,447,134	May 11, 1999	PLANAR LIGHT EMITTING DEVICE
6,257,491	March 6, 2000	PACKAGED MIRROR INCLUDING MIRROR TRAVEL STOPS
6,223,988 B1	October 14, 1997	HAND-HELD BAR CODE READER WITH LASER SCANNING AND 2D IMAGE CAPTURE
6,102,294	July 25, 1995	INTEGRATED SCANNER ON A COMMON SUBSTRATE
6,186,399	September 14, 1998	SCANNER AND MIRROR WITH SHAPE MEMORY ALLOY HINGES
6,092,728	July 12, 1999	MINIATURE LASER DIODE FOCUSING

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		MODULE USING MICRO-OPTICS
6,062,476	March 21, 1997	BAR CODE READERS USING SURFACE EMITTING LASER DIODE
6,059,188	April 12, 1996	PACKAGED MIRROR INCLUDING MIRROR TRAVEL STOPS
6,021,947	December 10, 1998	INTEGRATED CIRCUIT IMPLEMENTED ON A SEMICONDUCTOR SUBSTRATE IN A BAR CODE READER
Re: 36,528	March 24, 1995	OPTICAL SCANNING HEAD
5,988,506	June 16, 1996	SYSTEM AND METHOD FOR READING AND DECODING TWO DIMENSIONAL CODES OF HIGH DENSITY
5,986,745	March 24, 1997	CO-PLANAR ELECTROMAGNETIC PROFILE SCANNER
5,966,230	June 7, 1995	INTEGRATED SCANNER ON A COMMON SUBSTRATE
5,914,480	April 9, 1997	SCANNING DEVICE FORMED FROM INTEGRATED COMPONENTS ON A SEMICONDUCTOR SUBSTRATE
5,870,858	April 25, 1995	MOVING BODY RECOGNITION APPARATUS
5,859,418	January 25, 1996	CCD-BASED BAR CODE SCANNER WITH OPTICAL FUNNEL
5,828,050	October 31, 1997	LIGHT EMITTING LASER DIODE SCANNER
5,825,803	December 14, 1995	MULTIPLE EMITTER LASER DIODE ASSEMBLY WITH GRADED-INDEX FIBER MICROLENS
5,786,582	December 8, 1995	OPTICAL SCANNER FOR READING AND DECODING ONE- AND TWO DIMENSIONAL SYMBOLOGIES AT VARIABLE DEPTHS OF FIELD
5,717,221	October 11, 1996	MULTIPLE LASER INDICIA READER OPTIONALLY UTILIZING A CHARGE

		COUPLED DEVICE (CCD) DETECTOR AND OPERATING METHOD THEREFOR
5,710,417	June 2, 1995	BAR CODE READER FOR READING BOTH ONE DIMENSIONAL AND TWO DIMENSIONAL SYMBOLOGIES WITH PROGRAMMABLE RESOLUTION
5,625,483	August 25, 1993	INTEGRATED LIGHT SOURCE AND SCANNING ELEMENT IMPLEMENTED ON A SEMICONDUCTOR OR ELECTRO- OPTICAL SUBSTRATE
5,621,203	June 30, 1994	METHOD AND APPARATUS FOR READING TWO-DIMENSIONAL BAR CODE SYMBOLS WITH AN ELONGATED LASER LINE
5,615,003	November 29, 1994	ELECTROMAGNETIC PROFILE SCANNER
5,545,886	July 29, 1993	BARCODE SCANNER USING AN ARRAY OF LIGHT EMITTING ELEMENTS WHICH ARE SELECTIVELY ACTIVATED
5,532,467	July 2, 1996	OPTICAL SCANNING HEAD
5,378,883	July 19, 1991	OMNIDIRECTIONAL WIDE-RANGE HAND HELD BAR CODE READER
5,319,185	July 24, 1992	SMALL-SIZE HAND-SUPPORTED BAR CODE READER
5,319,181	March 16, 1992	METHOD AND APPARATUS FOR DECODING TWO-DIMENSIONAL BAR CODE USING CCD/CMD CAMERA
5,291,009	February 27, 1992	OPTICAL SCANNING HEAD
5,258,605	April 6, 1992	SCAN GENERATORS FOR BAR CODE READER USING LINEAR ARRAY OF LASERS
5,212,390	May 4, 1992	LEAD INSPECTION METHOD USING A PLANE OF LIGHT FOR PRODUCING REFLECTED LEAD IMAGES
5,192,856	November 19, 1990	AUTO FOCUSING BAR CODE READER

5,136,145	August 28, 1990	SYMBOL READER
5,032,960	February 14, 1990	LIGHT SOURCE DEVICE WITH ARRAYED LIGHT EMITTING ELEMENTS AND MANUFACTURING THEREFOR
4,979,815	February 17, 1989	LASER RANGE IMAGING SYSTEM BASED ON PROJECTIVE GEOMETRY
4,900,907	March 18, 1987	OPTICAL INFORMATION READING APPARATUS
4,826,299	January 30, 1987	LINEAR DEIVERGING LENS
4,743,773	August 21, 1985	BAR CODE SCANNER WITH DIFFUSION FILTER AND PLURAL LINEAR LIGHT SOURCE ARRAYS
4,741,621	August 18, 1986	GEOMETRIC SURFACE INSPECTION SYSTEM WITH DUAL OVERLAP LIGHT STRIPE GENERATOR
4,687,325	March 28, 1985	THREE-DIMENSIONAL RANGE CAMERA

FOREIGN PUBLICATIONS

<u>NUMBER</u>	<u>PUBLICATION DATE</u>	<u>TITLE</u>
WO 01/22033 A1	March 29, 2001	CMOS-COMPATIBLE THREE- DIMENSIONAL IMAGE SENSOR IC
WO 01/71419 A2	September 27, 2001	LARGE DEPTH OF FIELD LINE SCAN CAMERA
WO 01/72028 A1	September 27, 2001	COPLANAR CAMERA SCANNING SYSTEM
60/190,273	May 29, 2001	COPLANAR CAMERA
WO 99/64980	December 16, 1999	IMAGING ENGINE AND METHOD FOR CODE READERS
WO 99/21252	April 29, 1999	FILAMENTED MULTI-WAVELENGTH

VERTICAL-CAVITY SURFACE EMITTING LASER

TECHNICAL PUBLICATIONS

Web-based publication entitled "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc., www.accusort.com/products/coplanar.html, 1 page.

Product Brochure for the Accu-Sort AV3700 High Speed CCD Bar Code Reader by Accu-Sort Systems, Inc., Telford, Pennsylvania, March 2000, 2 pages.

Web-based Product Brochure on Model 120 LIVAAR Short Wave IR Gated Camera Specification, by Intevac Corporation, Santa Clara CA, September 2001, pages 1-2.

Web-based presentation entitled "NEW LIVAR IMAGERY" by Intevac Corporation, Santa Clara CA, http://www.intevac.com/livar_imagery/livar_imagery.html, 2001, pages 1-9.

Web-based brochure for Intevac Photonics Division Products- Laser Illuminated Viewing and Ranging (LIVAR) System, Intevac, Inc., <http://www.intevac.com/photonics/products.html>, 2001, pages 1-5.

Web-based brochure entitled "High-Speed, Repetitively Pulsed Ruby Laser Light Source" by Physical Sciences Inc., <http://www.psicvorp.com/html/prod/lasillum.htm>, 2001, pages 1-4.

Web-based brochure entitled "Collimated Laser Diode Arrays" by INO, Inc., http://www.ino.qc.ca/en/syst_et_compo/clda.asp, 2001, pages 1-2.

Product Brochure for the LasirisTM SNF Laser by StockerYale, Salem NH, 2001, pages 1-4.

Product brochure for DALSA IT-PA Image Sensors, by Dalsa, Inc., 2001 pages 1-14.

Product Specification for "KAF-4202 SERIES Full-Frame CCD Image Sensor Performance Specification" by Eastman Kodak Company, Rochester NY, June 29, 2000, pages 1-15.

User Manual for the Piranha CT-P4, CL-P4 High Speed Line Scan Camera by Dalsa, Inc., 2000, pages 1-30.

Product brochure for Sony ICX085AL 2/3-inch Progressive Scan CCD Image Sensor with Square Pixel for B/W Cameras, by Sony Corporation, 2000, pages 1-20.

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Scientific publication entitled "Laser triangulation: fundamental uncertainty in distance measurement" by Dorsch et al., Applied Optics, Vol. 33(7), March 1994, pages 442-450.

Scientific publication entitled "Optical Characterization of the State of Fabric Surfaces" by Marie-Ange Bueno, Bernard Durand and Marc Renner, Optical Engineer 39(6), June 2000, pages 1697-1703.

Scientific publication entitled "The Use of Diode Laser Collimators for Targeting 3-D Objects" by Clarke et al., Dept. Engineering/City Univ./London, 1994, pages 47-54.

User Manual for the Hand Held Products Dolphin® 7400 Handheld Computer by Hand Held Products, Inc., 2001, pages 1-90.

Product brochure for the Minolta VIVID 300 Non-Contact 3-D Digitizer by Minolta Corporation, Ltd., Japan, 2000, pages 1-2.

Product brochure for the Minolta VIVID 700 Non-Contact 3-D Digitizer by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Web-based product brochure for the Minolta VIVID 900 Non-Contact 3-D Digitizer by Minolta Corporation, Ltd., <http://www.minolta3d.com/products/vi900-en.asp#specs>, 2001, pages 1-3.

Minolta Application News entitled "3-D Shape Measurement of Human Face" by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Minolta Application News entitled "Numerical Analysis Simulation Computer Aided Engineering-(CAE)" by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Minolta Application News entitled "Rapid-Prototyping (Stereo Lithography System: STL)" by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Minolta Application News entitled "Rapid-Prototyping (Wood Molding for Vacuum Forming a Package)" by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Minolta Application News entitled "Surface Modeling (Reconstruction of NURBS Surface from a Real Model)" by Minolta Corporation, Ltd., Japan, 1997, pages 1-2.

Scientific Publication entitled "Automatic 3D Face Authentication" by Charles Beumier and Marc Acheroy, Royal Military Academy, Belgium, February 26, 1999, pages 1-13.

Scientific Publication entitled "Automatic Face Verification from 3D and Grey Level Clues" by Charles Beumier and Marc Acheroy, Royal Military Academy, pages 1-7.

INTERNATIONAL SEARCH REPORTS

App. No.

Filing Date

PCT/US01/44011

August 6, 2002

STATEMENT OF PERTINENCE

U.S. Patent No. 6,447,134 to Takahashi et al. discloses a planar light emitting device which has a planar light emitter. It has a layered structure composed of a transparent body and a semi-transparent body. The transparent body is made of a transparent synthetic resin containing no light scattering material. The semi-transparent body is made of a semi-transparent synthetic resin containing a light scattering material. The transparent body and the semi-transparent body are joined to form a diffusion layer therebetween. An LED array is disposed at one side of the planar light emitter. The diffusion layer has a sea-islands structure. An island resin has a dimension of 0.1 to 50 microns. The light entering the island resin attenuates therein without reflecting at once due to its complicated shape. Namely, the light entering the diffusion layer generates uniform brightness.

U.S. Patent No. 6,257,491 to Tan et al. discloses an integrated optical module for an optical scanner which has a lens spaced from a vertical-cavity surface-emitting laser (VCSEL) by a spacer of defined dimensions. The module, in an alternative embodiment, includes a wafer frame, a suspended mirror mounted for oscillation on the frame, a wafer substrate bonded beneath the frame and a wafer cover bonded above the frame. The cover includes a mirror travel stop to protect the mirror against shocks. A VCSEL mounted to the wafer cover produces a beam which is shaped and deflected by a diffractive optical element onto the oscillating mirror. The reflected beam passes out of the module toward an indicia to be read. Large numbers of such devices may be fabricated relatively cheaply using wafer-scale processing and assembly technology. Three large wafers are fabricated corresponding respectively to arrays of substrates, frames and covers. The large wafers are bonded together in a sandwich arrangement, and are then diced to produce the individual scan modules. The modules may provide either one-dimensional or two-dimensional scanning.

U.S. Patent No. 6,223,988 B1 to Batterman et al. discloses a hand-held bar code reader which includes a laser scanning module and a two dimensional image sensor and processor for reading a bar code. The laser scanner assists the 2D image processing by providing information on location, type, range, reflectivity, and presence of bar code for 2D reading. Additionally, the 2D image reading operation is improved by using the laser scan as a spotter beam for aiming.

U.S. Patent No. 6,102,294 to Swartz et al. discloses a light scanning system formed on a common substrate comprising a light scanner and a sensor. The light scanner scans light across a target. The sensor detects light reflected from the target and creates a signal representative of the detected light. The light scanner may include a light source and a deflector, such as a micro-machined scan module. The micro-machined scan module may comprise an electrode, a support mounted on the electrode, and a mirror element mounted at one end of the support, wherein a voltage applied between the electrode and mirror element bends the mirror element.

U.S. Patent No. 6,021,947 to Swartz discloses an integrated circuit for use in a bar code reader and method of making the same. The integrated circuit includes a semiconductor substrate, as well as a laser diode driver circuit and a digitizer circuit implemented on the substrate. The integrated circuit may also include a decoder circuit, a scan element driver circuit, a microcontroller, or a communications interface, each implemented on the substrate.

U.S. Patent No. 6,186,399 to Stern et al. discloses an integrated scanner for scanning a barcode is formed on a common substrate. The scanner may include a micro-machined mirror, a laser diode, and a detector, mounted on a single substrate or several connected substrates. Lenses can be used to focus a laser beam from the laser diode as well as expand a laser beam deflected by the micro-machined mirror. The scanner may also scan a barcode without using a micro-machined mirror by rotating the laser diode.

U.S. Patent No. 6,092,728 to Li et al. discloses a miniature module which emits and focuses a divergent light beam. The focusing module consists of a small-sized light emitter, such as a laser diode, and a micro-optical element seated in a lens holder. The outside diameter of the micro-optical element is 4 mm or less and preferably less than or equal to 2.5 mm. The micro-optical element may be a small conventional lens, a gradient index lens, or one of several types of diffractive optical element. The focal length of the module relative to the light from the emitter is set by sliding the lens holder along its central axis and permanently adhering it in place with respect to the emitter after focusing. During focal adjustment, axial rotation between the lens holder and between the base of the emitter is prevented by a series of notches. The miniature focusing module is small, lighter, costs less and may provide a larger relative aperture than the conventional structures currently used for example in solid state laser scanners.

U.S. Patent No. 6,062,476 to Stern et al. discloses a scanning device which incorporates a vertical cavity surface emitting laser (VCSEL). The laser diode may be mounted directly on and Si substrate which is adapted for movement to produce a scan pattern. A collimating lens may be directly mounted on the emitting surface of the laser. A plurality of lasers may be mounted on the substrate and operated in sequence without movement of the substrate to produce the effect of a scan. The scanning device emits visible or invisible light towards a target such as a bar code and a detector (mounted on the same or an adjacent substrate) senses the light reflected by the target to produce data which is decoded for further processing. A VCSEL uses low current and emits light from a relatively large area so that a relatively large amount of light is emitted for relatively small heat generation.

U.S. Patent No. 6,059,188 to diFazio et al. discloses an integrated optical module for an optical scanner which has a lens spaced from a vertical -cavity surface-emitting laser (VCSEL) by a spacer of defined dimensions. The module, in an alternative embodiment, includes a wafer frame, a suspended mirror mounted for oscillation on the frame, a wafer substrate bonded beneath the frame and a wafer cover bonded above the frame. The cover includes a mirror travel stop to protect the mirror against shocks. A VCSEL mounted to the wafer cover produces a beam which is shaped and deflected by a diffractive optical element onto the oscillating mirror. The reflected beam passes out of the module toward an indicia to be read. Large numbers of such devices may be fabricated relatively cheaply using wafer-scale processing and assembly technology. Three large wafers are fabricated corresponding respectively to arrays of substrates, frames and covers. The large wafers are bonded together in a sandwich arrangement, and are then diced to produce

the individual scan modules. The modules may provide either one-dimensional or two-dimensional scanning.

U.S. Patent No. RE. 36,528 to Roustaei discloses the design for a bar code scanner using the Light Emitting Diode (LED), Optical Scanner assembly and Charge-Coupled Devices (CCD) capable of reading the barcode symbols at the variable distance. An optical passive elements for increasing the depth of field and a method of fabricating the scanning head by mass-production techniques are also disclosed.

U.S. Patent No. 5,988,506 to Schaham et al. discloses a system for reading two dimensional codes as well as regular bar codes. A laser scanner generates a narrow horizontal beam which scans a code by means of a scanning mirror in the vertical direction. This mirror receives the reflected beam and passes it on to the lens array to yield high quality imaging characteristics all across a large field of view angle. The lens array and an auto focusing system produce images of the scanning lines in the sensor plane - a CCD linear array. In the sensor's plane, sub aperture diaphragms generate partially overlapping fields of view from each of the elements of the lens array. The system electronics converts the CCD linear array electrical signals into digital data. A module synthesizes in real-time the partially overlapping line sections of the image signal into an integrated continuous line signal and stores them consecutively in the image memory. A system processor operates an autofocus, as well as code classification and decoding algorithms.

U.S. Patent No. 5,986,745 to Hermary et al. discloses a co-planar system for determining the shape and dimensions of a surface of an object which includes a projector for projecting a spatially coded pattern of radiation, e.g., light, in a selected plane onto the object. The system also includes a receiving device capable of imaging the reflected pattern in the selected plane, and a discriminator for determining which portion of the reflected pattern corresponds to which portion of the projected pattern. By this means, a received signal representing less than the complete reflection from the projected pattern can be correlated with a discrete portion of the scanned object. The object is moved relative to the selected plane and the procedure repeated to obtain enough reliable data to generate a reasonably reliable surface profile. The resulting set of received signals and correlations are used to calculate the shape and dimensions of the object.

U.S. Patent No. 5,966,230 to Swartz et al. discloses an integrated scanner for scanning a barcode formed on a common substrate. The scanner may include a micro-machined mirror, a laser diode, and a detector, mounted on a single substrate or several connected substrates. Lenses can be used to focus a laser beam from the laser diode as well as expand a laser beam deflected by the micro-machined mirror. The scanner may also scan a barcode without using a micro-machined mirror by rotating the laser diode.

U.S. Patent No. 5,914,480 to Swartz discloses an optical reader for reading a target having a bar code to be read, in which a unitary semiconductor device is mounted in a housing having an opening. The unitary semiconductive device includes a semiconductive substrate and a plurality of integrated components at the surface of the semiconductive device for generating and directing a light beam outward from the surface of the substrate sequentially along a plurality of paths through the opening of the housing. A detector is disposed in the housing for intercepting reflected components of the outward-directed light beam. In two implementations, the light beam is directed respectively by a single movable reflector or by a plurality of deformable mirror

devices mounted on the substrate. The housing includes a grip, such as a pistol grip, at an extremity offset from the opening.

U.S. Patent No. 5,870,858 to Kamada et al. discloses a moving body recognition apparatus which recognizes a shape and movement of an object moving in relation to an image input unit by extracting feature points, e.g. a peak of the object and a boundary of color, each in said images captured at a plurality of instants in time for observation by the image input unit. The moving body recognition apparatus comprises an image input unit for capturing images of an object as a moving body having a rotation, a feature point extraction unit for extracting feature points from the images inputted by the image input unit, a feature point storage unit for storing known position data of the extracted feature points, and a shape/movement recognition unit for calculating the actual positions and movements of the feature points of the object in the images by using the known position data of the extracted feature points outputted from the feature point storage unit.

U.S. Patent No. 5,859,418 to Li et al. discloses an optical funnel which evenly distributes light from an array of LEDs to a bar code. A support member with a central aperture holds the LEDs. A shroud with an angled reflective interior surface spreads the light from the LEDs to the bar code. The funnel also optically isolates the LEDs from the photodetector in the scanner.

U.S. Patent No. 5,828,050 to Barkan et al. discloses a portable scanning head which emits and receives light from a light-emitting diode to read symbols, such as bar-code symbols. The optics within the scanner are operative for focusing a light beam and the view of a light sensor in different planes exteriorly of a scanner housing. Imaging means are provided in the unit for imaging a viewing window. The viewing window has an area smaller than that of the scan spot. The system can employ an LED as a light source and tolerate the relatively large-sized (on the order of millimeters) scan spot without sacrificing reading performance since the photodiode "sees" only that portion of the scan spot visible through the viewing window.

U.S. Patent No. 5,825,803 to Labranche et al. discloses a multiple emitters laser diode assembly which comprises a laser diode bar for emitting a laser beam. The laser diode bar comprises a plurality of emitters aligned with respect to each other in a same plane of emission. A graded-index elongated fiber microlens is transversely set at a given distance in front of the laser diode bar for controlling the divergence of the beam. The microlens has an axis of symmetry substantially intersecting the optical axis of each emitter. A mount is provided for positioning the microlens with respect to the laser diode bar. Alternatively, the assembly may comprise a laser diode array for emitting the beam. The laser diode array comprises a plurality of substantially parallel rows of emitters with a substantially regular period between them. An array of graded-index elongated fiber microlenses is positioned substantially parallel to the rows. Each microlens corresponds to one of the rows for collimating the beam generated thereby. The GRIN fiber microlens shows less alignment sensitivity than ordinary fiber lens or aspherical fiber lens when used in a multiple emitters laser diode assembly. The GRIN lens further has the advantage of collimating a laser diode bar or array with a high degree of quality while minimizing phase aberration and distortion in the collimated transmitted beam.

U.S. Patent No. 5,786,582 to Roustaei et al. discloses an optical device for reading one- and two-dimensional symbologies at variable depths of field, the device including a light source

for projecting an emitted light beam towards the two-dimensional image and an optical assembly, or zoom lens, with dual field of view capability for focusing light reflected from the framed symbology onto a CCD detector for detecting the focused light and generating a signal therefrom. The dual field of view capability enables scanning of both wide and narrow fields of view. An apodizing filter is provided within the optical assembly to increase depth of field. Aiming of the sensor to read the symbology is facilitated by a frame locator including a laser diode which emits a beam that is modified by optics, including diffractive optics, to divide the beam into beamlets having a spacing therebetween that expands to match the dimensions of the field of view of the sensor, forming points of light at the target to define the edges of the field of view. One or two sets of diffractive optics may be provided, with one set corresponding to each position, for each of the dual field of view positions of the zoom lens.

U.S. Patent No. 5,717,221 to Li et al. discloses an electro-optical scanning device which reads indicia having parts of different light reflectivity, including bar codes and matrix arrays such as UPSCODES. The scanning device includes laser or light emitting diodes for emitting at least two light beams of the same or different wavelengths. The light beams may be visible to the human eye, and the beams are optically directed to form one or two scan lines to scan portions of a symbol. Dual photosensor(s) or a charge coupled device detects light reflected from the different portions of the symbol. The charge coupled device can be used to detect either reflected ambient light or the reflected visible light from the beams emitted by the diodes. The photosensors generate signals corresponding to the detected light which can be processed simultaneously. The device is particularly useful in reading two dimensional or more complex symbols. Methods for reading indicia are also described.

U.S. Letters Patent No. 5,710,417 to Joseph et al. discloses hand-held linear images, in which a plurality of the areas of differing light reflectivity of a bar code symbol or the like which are simultaneously illuminated using, for example, a beam of light that has an elongated cross-section. The light beam is swept over the symbol to be read in a direction transverse to the elongated dimension of the illuminated region so that a two-dimensional area of the symbol is illuminated over time. The reflected light is sensed by a 1D CCD array. A microprocessor within the scanner provides visual feedback to aid a user in aligning the device, and also provides for a selectable aspect ratio for the image, a selectable image resolution and size, a selectable aspect ratio of the illumination, and a selectable pixel size. All of these options may be programmed within the microprocessor, enabling the device to read a large variety of two-dimensional symbols.

U.S. Patent No. 5,672,858 to Li et al. discloses a scanning device for reading indicia of differing light reflectivity, including bar code or matrix array symbols, which has a single light emitter, such as a laser or light emitting diode, for generating a scanning light beam to visually illuminate sequential portions of the indicia. A sensor, such as a charge coupled device (CCD) or other solid state imaging device, simultaneously detects light reflected from portions of the indicia and generates an electrical signal representative of the spatial intensity variations of the portions of the indicia. The scanning device may also include an ambient light sensor, and a second light emitter for use only in aiming or orienting the scanning device. A photodetector may also be provided to separately detect one symbol virtually simultaneous with the detection of another symbol by the sensor or to provide dual modalities. A method for reading indicia is also provided.

U.S. Patent No. 5,625,483 to Swartz discloses an integrated laser scanning device which includes: a substrate of semiconductor and/or electro-optical material, a laser light source disposed

on the substrate; and a scanner disposed on the substrate in the path of the laser beam for repetitively and cyclically moving the laser beam so as to form a scanning beam for repetitively scanning a target for reflection therefrom. In particular, the scanner comprises a layer of reflective material disposed on a moveable structure on the substrate, the plane of such layer being disposed at an acute angle with respect to the laser beam so that the beam is directed along an optical path toward indicia located in the vicinity of a reference plane lying in the optical path so as to scan spatially adjacent portions of the reference plane along a relatively elongated scanning line.

U.S. Patent No. 5,621,203 to Swartz et al. discloses a plurality of the areas of different light reflectivity of a bar code symbol, or the like, which are simultaneously illuminated using, e.g., a beam of laser light that has an elongated cross-section. The laser light beam is swept over the symbol in a direction transverse to the elongated dimension of the illuminated region so that a two-dimensional area of the symbol is illuminated over time, until the symbol is read. The light that reflects from the illuminated region of the symbol is imaged on a linear sensor array, which is then scanned or read out to produce signals representative of spatial intensity variations of the imaged light along a linear path in the field of view.

U.S. Patent No. 5,615,003 to Hermary et al. discloses a system for determining the shape and dimensions of a surface of an object which includes a projector for projecting onto the object a spatially coded pattern radiation, e.g., light. The system also includes a receiving device capable of imaging the reflected pattern, and a discriminator for determining which portions of the reflected pattern corresponds to which portion of the projected pattern. By this means, a received signal representing less than the complete reflection from the projected pattern can be correlated with a discrete portion of the scanned object. The procedure is repeated to obtain enough reliable data to generate a reasonably reliable surface profile. The resulting set of received signals and correlations are used to calculate the shape and dimensions of the object.

U.S. Patent No. 5,545,886 to Metlitsky et al. discloses a bar code scanner which employs an electronic means for causing the light beam to scan a bar code symbol, rather than using a mechanical device to generate the scan. A linear array of light sources, activated one at a time in a regular sequence, may be imaged upon the bar code symbol to simulate a scanned beam. Instead of a single linear array of light sources, a multiple-line array may be employed, producing multiple scan lines. The multiple scan lines may be activated in sequence, or activated simultaneously (time-division or frequency-division multiplexed). The multiple scan lines can provide signal enhancement, noise reduction or fault correction if directed to the same bar code pattern. Multiple scan lines may be generated using a single light source and a beam splitter, with mechanical scanning, as well as by the sequentially-activated light sources. Multiple simultaneous scan lines may be employed to generate a raster scan at lower mechanical scan frequency. In another embodiment, a tunable laser may be employed to provide a scan without moving parts; a laser beam from the tunable laser is reflected from a diffraction grating that produces an angular deviation dependent upon the wavelength of the laser output. As the frequency of the tunable laser is varied in some selected pattern, the laser beam will scan accordingly.

U.S. Patent No. 5,532,467 to Roustaei discloses an optical scanning head which includes at least one trio of light emitting diodes arranged so the LEDs emit light at different angles to create a fan of light. An optical module includes a light shield or "dark room" and a lens/filter assembly which provides control of the depth of focus of the scanner. The optical module is located behind the light source, and the detector, made up of a CCD array is mounted behind the optic module for

detecting the light intensity in the reflected beam over a field of view across a bar code symbol. The CCD array generates an electrical signal indicative of the detected light intensity. A DC source or battery provides DC voltage to the LEDs and CCDs in response to a clocked signal which provides a gradual or sequential illumination of the LEDs and coordinates the activation of the CCDs in order to minimize power consumption during scans.

U.S. Patent No. 5,378,883 to Batterman et al. discloses a hand-held bar code reader with a two dimensional image sensor for omnidirectional bar code reading, which includes variable imaging optics, and flash illumination with variable flash illumination optics. A spotter beam is provided for aiming the hand held bar code reader at a bar code symbol. The spotter beam is also used to measure the range to said bar code from said hand held bar code reader and to determine the focal length of said variable imaging optics and variable flash illumination optics. The imaging optics are adjusted automatically to provide the correct magnification and focus of a bar code regardless of range to the label. The variable focal length flash illumination optics are used to concentrate illumination energy only in the field of view of the bar code reader. The flash illumination energy is conserved by measuring the ambient light and setting the level of flash illumination energy in accordance with the measured level of ambient light. In such a manner, conventional, damaged, multiple, and stacked bar code symbols along with true two dimensional codes may be rapidly read over distances from under one foot to over several feet without having to align the bar code reader to the bar code.

U.S. Patent No. 5,319,185 to Obata discloses a bar code reader which has a sensor unit to be mounted on an operator's finger and a decoder unit to be mounted on an operator's wrist, the sensor and decoder units being electrically connected by a cable. The sensor unit has a light-emitting device for emitting light toward a bar code to be read, a graded-index rod lens array for focusing an entire linear optical image of the bar code at one time in substantially the same size as the bar code, and a line image sensor such as a CCD for photoelectrically converting the entire linear optical image focused by the optical means into an electric signal. The decoder unit decodes the electric signal from the line image sensor. The light-emitting device, the rod lens array, and the line image sensor are housed in a hollow casing. A movable tubular member is movably disposed in the hollow casing and has an end wall for abutment against the bar code. A switch for energizing the light-emitting device and the decoder unit is fixedly mounted in the hollow casing and triggerable by the movable tubular member when the movable tubular member is moved by abutment of the end wall thereof against the bar code.

U.S. Patent No. 5,319,181 to Shellhammer et al. discloses a method and apparatus for decoding a two-dimensional bar code symbol using a charge-coupled device (CCD) camera or a charge-modulation device (CMD) camera. The CCD/CMD camera takes pictures of the symbol and the picture is converted into digital data. The location and orientation of the two-dimensional bar code symbol is determined and verified. Defects and damages on the symbol are detected and corrected. The symbol is scanned to read the codewords of the two-dimensional bar code symbol.

U.S. Patent No. 5,291,009 to Roustaei discloses an ornamental design for a bar code scanner which uses the Light Emitting Diode (LED), Optical Scanner assembly and Charge-Coupled Devices (CCD) capable of reading the barcode symbols at the variable distance. The optical passive elements for increasing the depth of field and method of fabricating the scanning head by mass-production techniques are also disclosed.

U.S. Patent No. 5,258,605 to Metlitsky et al. discloses a bar code scanner which employs an electronic means for causing the light beam to scan a bar code symbol, rather than using a mechanical device to generate the scan. A linear array of light sources, activated one at a time in a regular sequence, may be imaged upon the bar code symbol to simulate a scanned beam. Instead of a single linear array of light sources, a multiple-line array may be employed, producing multiple scan lines. The multiple scan lines can provide signal enhancement, noise reduction or fault correction if directed to the same bar code pattern. Multiple scan lines may be generated using a single light source and a beam splitter, with mechanical scanning as well as by the sequentially-activated light sources. Multiple simultaneous scan lines may be employed to generate a raster scan at lower mechanical scan frequency. In another embodiment, a tunable laser may be employed to provide a scan without moving parts; a laser beam from the tunable laser is reflected from a diffraction grating that produces an angular deviation dependent upon the wavelength of the laser output. As the frequency of the tunable laser is varied in some selected pattern, the laser beam will scan accordingly.

U.S. Patent No. 5,212,390 to LeBeau et al. discloses a device which employs a laser diode and cylindrical lens to project a plane of laser at an incidence angle onto a plurality of leads. The light is simultaneously reflected from each of the plurality of leads. The light that is simultaneously reflected from each lead is detected by an image sensor. A digital computer computes the cotangent function of the incidence angle to detect an amount of displacement of at least one of the plurality of leads.

U.S. Patent No. 5,192,856 to Schaham discloses in Fig. 1 a hand-held imaging device for reading and interpreting bar codes which illuminates the bar code with a fixed elliptical light beam (produced by an LED and collimating and cylindrical lens), and images the reflected beam onto a linear CCD array which is aligned with the light beam. The black and white bar information is detected by the electronically scanned elements of a linear CCD array. The limited operational range, determined by the optical system depth of focus, is enhanced significantly to a useful operational range by automatically focusing the image of the bar code on the CCD array.

U.S. Patent No. 5,136,145 to Karney discloses a symbol reader that uses a dynamic random access memory as a detector element and a gradient refractive index material as the lens to capture a symbol image. The rod shaped lens passes through an opaque cover and confronts the array of memory elements in the memory. The cover is glued to a memory device package. The PN junctions of the random access memory are activated by light reflected from a symbol and appear as data when the random access memory is read out. The light can be provided by light emitting diodes positioned adjacent to the memory package and in a handheld wand that includes a light reflecting shield in which the symbol is positioned for reading. The wand is positioned over the symbol and a read button is depressed. A computer monitoring the read button activates the light emitting diodes and then reads out the contents of the random access memory, unscrambles the data, signals the user that the symbol has been captured and then outputs the symbol image.

U.S. Patent No. 5,032,960 to Katoh discloses a light source device with arrayed light emitting elements which includes a base board on which a plurality of the light emitting elements are arranged in an array, a convergent rod lens provided parallel to the array of the light emitting elements, and a reflection casing for holding the convergent lens. The convergent lens and the reflection casing are integrally connected with an air-gap formed parallel to the convergent lens. The base board is secured upon being inserted into the air-gap. The convergent lens and reflection

casing in the light source device with arrayed light emitting elements can integrally and simultaneously be molded by continuous two-color extrusion molding. Therefore, it is possible to manufacture the light source device with arrayed light emitting elements at lower cost and which can easily be assembled with a reduced number of parts.

U.S. Patent No. 4,979,815 to Tsikos discloses a range imaging system, and a method for calibrating such a system which are based on the principles of projective geometry. The system comprises four subsystems: (1) a laser and a cylindrical lens or vibrating mirror for producing a planar beam of light; (2) an electronic camera equipped with a lens and an appropriate interference filter; (3) an electronic circuit for height (depth) measurements and video image generation; and (4) a scanning mechanism for moving the object with respect to the light beam and the camera so as to scan an area of the object surface. The system is calibrated by determining the position in the electronic image of the object surface at three different heights. The range image is generated from these three known heights from either a previously determined look-up table, or from a calculation based on the invariance of the cross-ratio, a well known ratio from projective geometry.

U.S. Patent No. 4,900,907 to Matusima et al. discloses a handheld reader for reading optical information such as a bar code contains a reading sensor. An image of the optical information is imaged by light produced by a pair of LEDs and reflected from the optical information, via a reflecting mirror, a lens and a diaphragm member, onto the reading sensor so that the image is converted into an electric signal. The pair of LEDs are disposed on both sides of the image sensor so that the images thereof are imaged near the optical information by light from the LEDs through the diaphragm member, the lens and the reflecting mirror. The LEDs and reading sensor are controlled so that the LEDs are disabled from emitting light while the reading sensor performs the reading operation of the optical information.

U.S. Patent No. 4,826,299 to Powell discloses a lens which has the appearance of a prism with a relatively sharp radius at the apex. This lens finds an application in expanding a laser beam in one direction only.

U.S. Patent No. 4,687,325 to Corby, Jr. discloses a three-dimensional range camera system which measures distance from a reference plane to many remote points on the surface of an object. The set of points at which range is measured lie along a straight line (N points) or are distributed over a rectangular plane ($M \times N$ points). The system is comprised of a pattern generator to produce a $1 \times N$ array of time/space coded light rays, optionally a means such as a rotating mirror to sweep the coded light rays orthogonally by steps, a linear array camera to image subsets of the light rays incident on the object surface, and a high speed range processor to determine depth by analyzing one-dimensional scan signals. The range camera output is a one-dimensional profile or a two-dimensional area range map, typically for inspection and robotic vision applications.

U.S. Patent No. 4,743,773 to Katana et al discloses a bar code scanner applicable for use to scan various bar codes of different standards and sizes. Any malfunction due to non-uniform illumination of the bar code or maloperation can be prevented, and also the light source may not be normally turned on. This bar code scanner is usable as held by hand or fixed as desired. The opening of the scan head of the inventive bar code scanner is formed polygonal, and high light-transmission diffusion filter is provided between the light source and the opening. The light source consists of spot light sources disposed in plural linear arrays including the ones which are

normally on for sensing the proximity to a bar code and the others which are turned on and off depending on whether the scan head is near or far from a bar code. Furthermore, the scan head enclosure consists of a gripping portion for the operation of the scanner as held by hand and a flat bottom portion for use in operating the scanner as fixed; both portions are integrally formed to be the enclosure in which a light source, photodetector, decoder and interface subside.

U.S. Patent No. 4,741,621 to Taft et al. discloses a surface inspection system with a single light source producing two light stripe sheets projected from different angles onto an inspected surface so that a combined light sheet produces a light stripe image with no shadow results. The two light stripe sheets are created by tangentially reflecting a laser beam off of separate cylindrical reflectors. The light stripe is detected by an imaging system, including a camera having a CCD image array, held at a fixed angle with respect to the light sheet which allows the two-dimensional curvature of the stripe to be detected. The two-dimensional light stripe image is converted into a digital image and processed by linear and logical digital filters that narrow the stripe down to two pixels wide. A coordinate extraction apparatus extracts the coordinates of the bottom row of the pixel image producing a digital representation of the light stripe curve. The sample curve is compared by a computer with a reference curve by obtaining the absolute value of the difference in height of points along the sample and reference curves after alignment and comparing the absolute value to an error or tolerance threshold. Any deviation beyond the fixed tolerance is reported as a surface irregularity defect.

WIPO Publication No. WO 01/22033 A1 by Canesta, Inc., discloses a three-dimensional imaging system which includes a two-dimensional array of pixel light sensing detectors and dedicated electronics and associated processing circuitry fabricated on a common IC using CMOS fabrication techniques. In one embodiment, each detector has an associated high speed counter that accumulates clock pulses in number directly proportional to time of flight for a system-emitted pulse to reflect from an object point and be detected by a pixel detector focused upon that point. The TOF data provides a direct digital measure of distance from the particular pixel to a point on the object reflecting the emitted light pulse. In a second embodiment, the counters and high speed clock circuits are eliminated, and instead each pixel detector is provided with a charge accumulator and an electronic shutter such that each pixel detector accumulates charge, the amount of which provides a direct measure of round-trip TOF.

WIPO Publication No. WO 01/71419 A2 by Accu-sort Systems, Inc., discloses a scanning system which utilizes a randomly addressable image sensor which is selectively positioned at the Scheimpflug angle in the image plane in order to detect focused light reflected from an object. Light reflected from the object is focused onto the sensor through an objective lens. Since the sensor is mounted at the Scheimpflug angle, each strip within the depth of field of the object plane has corresponding pixels on the sensors which are in focus.

WIPO Publication No. WO 01/2028 A1 by Accu-sort Systems, Inc., discloses a system for scanning objects having a linear array sensor, adapted to detect light input signals. A lens is optically connected to the linear array sensor, and is adapted to receive and transmit an optical image located in a field of view along a lens axis to the linear array sensor. A light source which generates an illumination stripe in general linear alignment with the lens axis is provided. A cylindrical lens is positioned between the light source and an object to be scanned. The cylindrical lens adapted to collect, transmit and focus light from the light source to form the illumination stripe.

U.S. Provisional Application No. 60/190,273 by Chaleff et al. publishes as WIPO International Publication No. WO 01/72028 A1, discloses an optical scanning system containing a coplanar camera utilizing a LED array light source and a linear CCD sensor array.

WIPO Publication No. WO 99/64980 by Symbol Technologies, Inc. discloses an imaging engine and signal processing devices and methods for reading various kinds of optical codes. The compact structure (54") may include a two-dimensional image sensor, apparatus for focusing images at different focal disclosures, a laser-beam type aiming system, a hi-low beam illumination system employing an array of LEDs on lenslet plate (50), and related signal processing circuits.

WIPO Publication No. WO 99/21252 by Honeywell, Inc. describes a Vertical-Cavity surface Emitting Laser (VCSEL) for producing a filamented light output. In a preferred embodiment, this is accomplished by providing a number of discrete objects that are positioned adjacent to or within one or both of the cladding mirrors, or within the active region itself. The discrete objects may alter the reflectance, current injection and/or gain of the VCSEL at corresponding discrete locations, thereby causing the filamented light output. Besides providing a filamented output, the VCSEL operates at a low drive current, provides high performance, and occupies less physical area than a broad-area (wide aperture) VCSEL. Thus, the VCSEL has a number of advantages provided by a conventional laser including speed, efficiency and power, but does not suffer from many of the disadvantages of high coherence. The utilization of speckle averaging within multi-mode fiber interconnections and CD-like spatial imaging applications are contemplated.

The web-based publication for the "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc. describes coplanar lighting technology that concentrates critical light on the target surface in the linear read area. This concentrated illumination feature allows high-speed, high-resolution image capture using a low-power LED light source. Coplanar LED illumination eliminates the mounting angle between the line of sight of the camera and the light source. This maximizes the return light and allows for a lower intensity light source.

The Accu-Sort Product Brochure for the AV3700 High Speed CCD Bar Code Reader describes a CCD camera that can be mounted over the belt or for side- and bottom-read applications. A new low-power, high-intensity LED-based illumination option, which can be used with the AV3700 Reader, offers the same image quality and read rate performance as the standard sodium vapor lamps, and eliminates glare for side and bottom reading.

The Intevac Product Brochure for the Model 120 LIVAR Short Wave IR Gated Camera describes a range-gated, laser-illuminated, two-dimensional imaging system that operates in the "eye-safe" wavelength band.

The web-based publication for the Intevac New LIVAR Imagery system (http://www.intevac.com/livar_imagery/livar_imagery.html) exhibits the Laser Illuminated Viewing and Ranging (LIVAR) system which is designed for range-gated imaging in the 1.5um band.

The scientific publication entitled "High-Speed, Repetitively Pulsed Ruby Laser Light Source" by Physical Sciences Inc. describes the development of a high-repetition rate, multi-pulsed ruby laser as a light source for high-speed events. This red light laser incorporates

repetitive Q-switching technology to achieve high individual pulse energies sufficient to overcome the self-luminosity of a supersonic bow shock.

The website for INO, Inc.'s "Collimated Laser Diode Arrays" describes laser diode arrays which are collimated using microlens collimation technology. Microlens collimation increases the laser diode array brightness by more than two orders of magnitude. Beam divergence depends on laser array size and is typically $2.0^\circ \times 1.0^\circ$ FWHM for large, high-density multi-bar arrays but can be nearly diffraction-limited for single-bar arrays. The highly diverging "fast" axis is collimated using a proprietary GRIN cylindrical microlens array and the "slow" axis is collimated using a plano-convex cylindrical microlens array. These microlens arrays are permanently attached to the laser array assembly and are mechanically robust and insensitive to vibration and temperature variations.

The StockerYale Product Brochure for the LasirisTM SNF Laser describes LasirisTM SNF beam shaping optics which transforms the familiar laser dot into different shapes and sizes. For example, a straight line can be projected by allowing one dimension of light to fan out while maintaining tight control over the other, resulting in a sheet-of light. This laser system incorporates an optical line generator that eliminates gaussian distribution of the light.

The DALSA, Inc. Product Brochure for the DALSA IT-P4 Image Sensors describe the Dalsa IT-P4 sensor as having feature 4096, 6144, or 8192 elements and using proprietary technology to provide four outputs at 40MHz each. The DALSA IT-P4 Image Sensor employs buried channel CCD shift registers to maximize output speed and reduce noise. The IT-P4 sensor has a dynamic range of $>1600:1$ and a linear dependence on light level up to saturation. The exposure control of the IT-P4 sensor allows integration times shorter than the readout time.

The Eastman Kodak Company Product Brochure for the KAF-4202 Series Full-Frame CCD Image Sensor describes a high performance monochrome area CCD image sensor with $2032 \text{ H} \times 2044 \text{ V}$ photo active pixels designed for a wide range of image sensing applications in the 0.4 nm to 1.0 nm wavelength band. Typical applications include military, scientific, and industrial imaging. A 74dB dynamic range is possible operating at room temperature.

The Camera User's Manual for the DALSA Piranha CT-P4, CL-P4 High-Speed Line-Scan Camera describes a modular camera which uses the reliability, flexibility, and cost-effectiveness of high-volume interchangeable parts. Within the Piranha camera, a timing board (PB-P1-X206) generates all internal timing and a driver board (PB-P1-X139) provides bias voltages and clocks to the CCD image sensor. For enhanced dynamic range, one or two A/D board (PB-xx-D344) process the video and digitize it to 10 bits before outputting the most significant 8 bits.

The Sony Product Brochure for the ICX085AL Progressive Scan CCD Image Sensor Chip describes a $2/3$ -inch interline CCD solid-state image sensor with a square pixel array. Progressive scan allows all pixel signals to be output independently within approximately $1/12$ second. This sensor chip features an electronic shutter with variable charge-storage time which makes it possible to realize full-frame still image without a mechanical shutter. High sensitivity and low dark current are achieved through the adoption of HAD (Hole-Accumulation Diode) sensors.

The Mitsubishi Product Brochure for the ML1XX6 series laser diodes describes a high power AlGaInP semiconductor laser which provides a stable, single transverse mode oscillation

with emission wavelength of 658-nm and standard CW light output of 30mW.

The article entitled "Laser triangulation: fundamental uncertainty in distance measurement" by Dorsch et al. discusses the uncertainty limit in distance sensing by laser triangulation. The uncertainty in distance measurement of laser triangulation sensors and other coherent sensors is limited by speckle noise. Speckle arises because of the coherent illumination in combination with rough surfaces. A minimum limit on the distance uncertainty is derived through speckle statistics. This uncertainty is a function of wavelength, observation aperture, and speckle contrast in the spot image. Surprisingly, it is the same distance uncertainty obtained from a single-photon experiment and from Heisenberg's uncertainty principle. An uncertainty principle connecting lateral resolution and distance uncertainty is introduced. Design criteria for a sensor with minimum distance uncertainty are determined: small temporal coherence, small spatial coherence, a large observation aperture.

The scientific publication entitled "Optical Characterization of the State of Fabric Surfaces" by Bueno et al. describes the implementation of two optical method for characterizing the state of fabric surfaces: a multidirectional roughness meter and a hairiness meter. A textile fabric has a complicated texture in that the relevant components (fibers) are not very small (usually at least 10 μm in diameter), but in the fabric are partly ordered (in the yarn) and partly disordered (in the superficial hairiness). Hairiness is important in giving a textile fabric a characteristic surface. It makes the effective surface three-dimensional with many hidden areas. Thus, characterizing the state of a fabric surface requires special devices. On the one hand, the presented roughness meter measures essentially the fabric reflected rays in all surface directions, because the fabric is rotated in its plane during the measurement. A Fourier temporal analysis of the reflected beam scanned across the fabric surface allows the fabric structure periods to be determined, because these periods yield peaks in the frequency spectrum. Two examples are given that show that the peak heights characterize the state of the fabric surface. On the other hand, the hairiness meter measures the hairiness of the fabric surface by an edge extraction method, which separates hairiness and structural information. The two devices are complementary and allow the processes that modify the fabric surface to be understood and controlled.

The scientific publication entitled "The Use of Diode Laser Collimators for Targeting 3-D Objects" by Clarke et al. describes the theory of speckle, the magnitude of the location error due to speckle, and methods which can minimize or remove the effect of speckle.

The User Manual for the Hand Held Products Dolphin ® 7400 Handheld Computer describes the features and functions of the handheld computer, which include a 206MHz RISC processor and Windows CETM operating system that is easily programmable with standard programming tools.

The product brochures for the Minolta VIVID 300, VIVID 700, and VIVID 900 Non-Contact 3-D Digitizer describes a portable, high-speed, and compact 3-D digitizer.

The Minolta Application News publication entitled "3D Shape Measurement of Human Face" describes a cosmetics manufacturer's use of the Minolta VIVID 700 Non-Contact 3D Color Digitizer in human facial expression research.

The Minolta Application News publication entitled "Numerical Analysis Simulation

Computer Aided Engineering –(CAE)” describes the use of the Minolta VIVID 700 Non-Contact 3D Digitizer to construct 3D data for Computer Aided Engineering (CAE) from real models.

The Minolta Application News publication entitled “Rapid-Prototyping (Stereo Lithography System: STL)” describes the use of the Minolta VIV 700 Non-Contact 3D Digitizer to create, view, edit and scale replica models of various kinds of objects, such as new product design, medication applications like prosthesis, simulation of rare artifacts, etc.

The Minolta Application News publication entitled “Rapid Prototyping (Wood Molding for Vacuum Forming A Package)” describes the use of the Minolta VIVID 700 Non-Contact 3D Color Digitizer to design plastic packaging for product packaging.

The Minolta Application News publication entitled “Surface Modeling (Reconstruction of NURBS Surface from a Real Model)” describes the use of the Minolta VIVID 700 Non-Contact 3D Digitizer with a surface modeler to reconstruct 3D surface data for CAD (Computer Aided Design) from a real model.

The scientific publication entitled “Automatic Face Verification from 3D and Grey Level Clues” by Beumier et al. describes automatic face verification from 3D facial surface and grey level analysis. 3D acquisition is performed by a structured light system, adapted to face capture and allowing grey level acquisition in alignment. The 3D facial shapes are compared and the residual error after 3D matching is used as a first similarity measure. A second similarity measure is derived from grey level comparison. As expected, fusing 3D and grey level information increases verification performances. The acquisition system, the 3D and grey level comparison algorithms were designed to be integrated in security applications in which individuals cooperate.

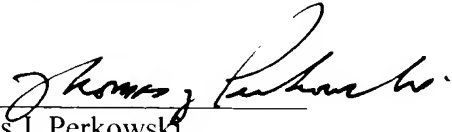
The scientific publication entitled “Automatic 3D Face Authentication” by Beumier et al. describes automatic face authentication from facial surface analysis. This geometrical approach was motivated by difficulties encountered when considering frontal face recognition. Apart from being less sensitive to viewpoint and lighting conditions, the method exploits information which is complementary to grey level based approaches, enabling the fusion with those techniques. A 3D acquisition system based on structured light and adapted to facial surface capture is presented. It is cheap and fast while offering a sufficient resolution for face recognition purposes. The acquisition system and the 3D face comparison algorithm were designed to be integrated in security applications with cooperative scenario.

A separate listing of the above references on PTO Form 1449 and a compact disc containing copies of these references in .pdf format are enclosed herewith for the convenience of the Examiner.

The Commissioner is also hereby authorized to charge any fee deficiencies to Deposit Account No. 16-1340.

Respectfully submitted,

Dated: October 31, 2002

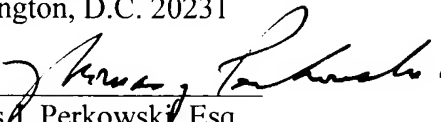

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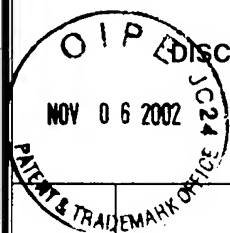
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Thomas J. Perkowski, Esq.
Reg. No. 33,134
Dated: October 31, 2002

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**INFORMATION
DISCLOSURE STATEMENT
BY APPLICANTS**

Sheet

1

of

8

Complete If Known

Application Number	10/068,462
Filing Date	February 7, 2002
First Name Inventor	Pirooz Vatan
Group Art Unit	2876
Examiner Name	n/a
Attorney Docket Number	108-151USAN10

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intn'l Class / Sub Class
		Number	Kind Code (if known)			
		6,223,988 B1		Batterman et al.	05/01/2001	G06K 7/10
		Re: 36,528		Roustaei	01/25/2000	G06K 7/10
		5,988,506		Schabam et al.	11/23/1999	G06K 07/10
		5,986,745		Hermay et al.	11/16/1999	G01B 11/24
		5,872,858		Kamada et al.	02/16/1999	G06K 9/00
		5,859,418		Li et al.	1/12/1999	G06K 7/10
		5,828,050		Barkan	10/27/1998	G06K 7/10
		5,825,803		Labranche et al.	10/20/1998	H01S 3/08
		5,786,582		Roustaei et al.	07/28/1998	G02B 26/08
		5,717,221		Li et al.	02/10/1998	G06K 7/10

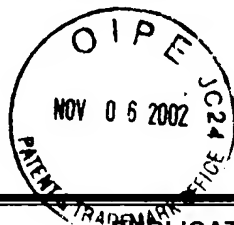


U.S. PATENT DOCUMENTS

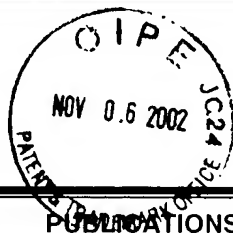
Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intr'l Class / Sub Class
		Number	Kind Code (if known)			
		5,710,417		Joseph et al.	01/20/1998	G06K 7/10
		5,621,203		Swartz at al.	05/15/1997	G06K 7.10
		5,615,003		Hermay et al.	03/25/1997	G01B 11/24
		5,545,886		Metlitsky et al.	08/13/1996	
		5,532,467		Roustaei	07/02/1996	G06K 7/10
		5,378,883		Batterman et al.	01/03/1995	G06K 7/10
		5,319,185		Obata	06/07/1994	G06K 7/10
		5,319,181		Shellhammer et al.	06/07/1994	G06K 7/10
		5,291,009		Li et al.	02/10/1998	G06K 7/10
		5,258,605		Metlitsky et al.	11/02/1993	G06K 7/14
		5,212,390		LeBeau et al.	05/18/1993	G01V 9/04
		5,192,856		Schaham	03/09/1993	G06K 7/10
		5,136,145		Karney	08/04/1992	G06K 13/00

**U.S. PATENT DOCUMENTS**

Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intr'l Class / Sub Class
		Number	Kind Code (if known)			
		4,979,815		Tsikos	12/25/1990	G01C 3/00
		4,900,907		Matusima et al.	02/13/1990	
		4,826,299		Powell	05/02/1989	G02B 13/18
		4,743,773		Katana et al.	05/10/1998	G06K 7/10
		4,741,621		Taft et al.	05/03/1988	G01B 11/24
		4,687,325		Corby	08/18/1987	G01C 3/00



PUBLICATIONS		
Examiner Initials	Cite No.	Description
		Web-based publication entitled "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc., www.accusort.com/products/coplanar.html , 1 page.
		Product Brochure for the Accu-Sort AV3700 High Speed CCD Bar Code Reader by Accu-Sort Systems, Inc., Telford, Pennsylvania, March 2000, 2 pages.
		Web-based Product Brochure on Model 120 LIVAAR Short Wave IR Gated Camera Specification, by Intevac Corporation, Santa Clara CA, September 2001, pages 1-2.
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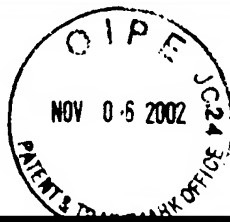


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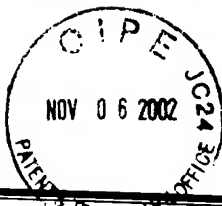


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FOREIGN PATENT DOCUMENTS

Examiner Initials		Foreign Patent Document			Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intr'l Class / Sub Class	T *
		Office	Number	Kind Code (if known)				
		PCT	WO 01/22033 A1		Canesta, Inc.; Santa Clara, CA	03/29/2001	G01C 3/08	
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Examiner Initials	Cite No.	Description
		2002 Search Report for International Application No. PCT/US01/44011

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